ELEVENTH ANNUAL REPORT

OF

RUTGERS

SCIENTIFIC SCHOOL,

THE STATE COLLEGE.

FOR THE BENEFIT OF AGRICULTURE AND MECHANIC ARTS,

FOR THE YEAR

1875.

NEW BRUNSWICK, N. J.

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1875.

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*HENRY K. HOW, *Secretary.*

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* Deceased.

TRUSTEES' REPORT.

Rutgers College,
New Brunswick, N. J., Nov. 15th, 1875.

To His Excellency, Joseph D. Bedle, Governor of the State of New Jersey:

Sir—I beg leave, in behalf of the Trustees of Rutgers College, to submit the Eleventh Annual Report of Rutgers Scientific School, in accordance with the requirements of the act of congress, approved July 2d, 1862, and of the act of the legislature of the state of New Jersey, approved April 4th, 1864.

There have been no changes during the past year, either in the general policy of the institution, or in the composition of the Faculty.

I. FACULTY OF RUTGERS SCIENTIFIC SCHOOL.

The Faculty is now constituted as follows:

Rev. Wm. H. Campbell, D. D., LL. D., President, and Professor of Moral Philosophy.

George H. Cook, Ph. D., LL. D., Vice President, and Professor of Chemistry, Natural History and Agriculture.

David Murray, Ph. D., LL. D., Professor of Natural Philosophy and Astronomy.

Rev. Theodore S. Doolittle, D. D., Professor of Rhetoric, Logic, and Mental Philosophy.

John C. Smock, A. M., Professor of Mining and Metallurgy.

George W. Atherton, A. M., Professor of History, Political Economy and Constitutional Law.

Rev. Carl Meyer, D. D., Professor of French and German.

Francis C. Van Dyck, A. M., Professor of Analytical Chemistry.

Edward A. Bowser, M. S., C. E., Professor of Mathematics and Engineering.

Charles G. Rockwood, A. M., Ph. D., Professor of Natural Philosophy and Astronomy.

Isaac E. Hasbrouck, A. M., Adjunct Professor of Mathematics and Graphics.

II. COURSES OF STUDY AND DEGREES.

The courses of study in the Scientific School are as follows:

1. A COURSE OF FOUR YEARS, IN CIVIL ENGINEERING AND MECHANICS.

2. A COURSE OF FOUR YEARS, IN CHEMISTRY AND AGRICULTURE.

3. A SPECIAL COURSE OF TWO YEARS, IN CHEMISTRY.

The special course in Chemistry is intended for the convenience of students who wish to devote themselves exclusively to that branch of study. Ample facilities are provided for them in the Laboratory and Lecture Rooms for the full employment of their time, and, on completing the course, they receive a certificate to that effect.

Provision is also made for PARTIAL STUDENTS, who may enter at any time, and elect, under the advice and direction of the Faculty, such studies as they may be found qualified to pursue, with classes already formed. Such students are subject to the general regulations and discipline of the institution. They are required to have their time fully occupied, and to pass such examinations as may be prescribed in each case. On leaving, they receive certificates, stating the studies pursued, and the amount of work performed in each.

The two principal courses cover a period of four years each. The studies of the first two years are the same in both, and are arranged with special reference to the wants of young men who desire to fit themselves to become land surveyors, or to enter any department of skilled industry, but are unable to remain four years in the institution. Students who leave at the end of this short course, receive certificates.

At the end of the two years' course, students elect whether to pursue the course in Civil Engineering and Mechanics, or that in Chemistry and Agriculture, and for the remaining two years their studies are directed with particular reference to the choice made. Some studies, however, of a general nature, such as History, English Literature, Political Economy, Moral Philosophy and others, are interspersed throughout the entire four years, in order that students may not only acquire a thorough preparation for their special pursuits in life, but may at the same time receive a liberal training which will fit them to discharge wisely and usefully, the duties of good citizenship.

Students completing either of the four years' courses, receive the degree of Bachelor of Science.

Graduates of three years' standing, receive the degree of Master of Science, in course.

The degrees of Civil Engineer and Doctor of Philosophy are conferred for distinguished professional success, or, on examination in prescribed subjects.

A schedule of the several courses of study accompanies this report.

III. TERMS OF ADMISSION.

The conditions of admission to the regular courses of study remain the same as for the last four years.

Applicants must be sixteen years of age, and of good moral character, and, if coming from other institutions, must bring certificate of honorable dismission. They must pass a satisfactory examination in English Grammar and Spelling, Geography (descriptive,) Physical Geography, History of the United States, Arithmetic, Algebra to Equations of the second degree, and Three Books of Plane Geometry.

The regular examinations for admission to the Freshman Class are held on Saturday and Monday preceding the annual commencement, and on the day before the opening of the fall term. Candidates for advanced standing are examined in the preparatory studies, and in those already pursued by the class which they propose to enter.

IV. STUDENTS AND STUDIES.

The classes now in the Institution are:

First. The Senior class, organized in September, 1872, which will be graduated in June, 1876.

Second. The Junior class, organized in September, 1873, which will be graduated in June, 1877.

Third. The Sophomore class, organized in September, 1874, which will be graduated in June, 1878.

Fourth. The Freshman class, organized in September, 1875, which will be graduated in June, 1879.

The Senior class now consists of three students; the Junior class, of fifteen students; the Sophomore class, of ten students; and the Freshman class, of seventeen students; making a total of forty-five now in attendance.

There have been in the Institution, during the year, seventy students, of whom four were from Japan, one from England, one from the state of Alabama, one from the state of Illinois, one from the state of Pennsylvania, eleven from the state of New York, one from the District of Columbia, and the remaining fifty from the state of New Jersey, representing twelve counties, as follows:

Atlantic,	1
Essex,	5
Gloucester,	1
Hudson,	2
Hunterdon,	1
Mercer,	1
Middlesex,	19
Monmouth,	1
Morris,	3
Passaic,	1
Somerset,	2
Union,	13

Under the law of New Jersey, designating this Institution as "the State College for the benefit of Agriculture and the Mechanic Arts, forty students from this state are entitled to be received into the Scientific School, and remain through the entire course free of expense for tuition. These students are admitted on the recommendation of the superintendent of schools in each county, and are distributed among the counties in proportion to representation in the legislature, as follows:

Atlantic,	1	Middlesex,	2
Bergen,	1	Monmouth,	2
Burlington,	3	Morris,	2
Camden,	2	Ocean,	1
Cape May,	1	Passaic,	2
Cumberland,	1	Salem,	1
Essex,	6	Somerset,	1
Gloucester,	1	Sussex,	1
Hudson,	6	Union,	2
Hunterdon,	1	Warren,	1
Mercer,	2		

It has been the established policy of the trustees to construe the provisions of this law in the most liberal spirit; and, accordingly, in cases where applications have not been received from any county for the full number of free scholarships, to which it was entitled, they have considered themselves at liberty to fill them, temporarily, with the consent of the county superintendent, with applicants from other counties, in excess of the number to which they were entitled. It would be gratifying to the Trustees, however, if the superintendents of schools, and the friends of industrial education generally, in counties that are not now represented, would interest themselves to see that their promising young men prepare themselves to compete for the free scholarship which the bounty of the United States and of this state have provided for them. The Trustees have also remitted tuition every year to a considerable number of young men, in addition to those holding state scholarships.

Only a single class has yet graduated since the course of study was lengthened from three years to four, and it is too soon, therefore, to state with any certainty the results of that change. There is, however, no reason to doubt its entire wisdom, and enough has already appeared in the increased breadth and thoroughness of the work of the several classes to justify us in believing that our best anticipations will be fulfilled.

In previous reports, we have had occasion to remark that the great body of the young men who leave the Scientific School, whether at or before the end of the full course, engage in industrial pursuits instead of entering the learned professions. This continues to be true, and is in full accordance with the spirit and method of the instruction here given, as well as with the nature of the studies pursued. Every subject is taught with constant reference to its practical applications, and students thus become familiar not merely with the underlying principles of their science, but to some considerable extent, with the best methods employed in actual work. The student in Surveying performs the actual work of a surveyor; the student in Chemistry learns to make his own analyses and computations; and the student in Engineering studies the construction of works at various stages of their progress. One of the most noticable and interesting of the results of this method is found in its effect upon the temper and conduct of the students themselves. Cases of serious discipline in the Scientific School are of the rarest possible occurrence; and while this may be due in part to the earnest and manly character of the young men themselves, who represent largely the real yeomanry of the state, we cannot but think it is in good part attributable to the fact that they are made to see, at every stage of their work, its direct bearing upon the practical business of life upon which they expect soon to enter. It is the aim of the Trustees and Faculty to continue in the direction which has already yielded such good results, and to raise the standard of requirements, both for admission and graduation, as rapidly as the better preparation of students will enable them to do so.

V. THE AGRICULTURAL DEPARTMENT AND STATE FUND.

The operations and condition of the Agricultural Department are fully set forth in the accompanying report of the Professor of Agriculture, to which your attention is respectfully invited. The careful experiments with soils, crops, fertilizers, &c., which have been systematically conducted on the College Farm for several years, have already yielded useful results, and it is gratifying to find that they are every year becoming better appreciated and more highly valued by intelligent farmers in every part of the state. An increase of funds for the prosecution of this work is greatly needed.

The amount received from the state treasurer for the fiscal year, ending October 31st, 1875, is six thousand nine hundred and sixty dollars ($6,960,) which has been expended exclusively for the salaries of professors in the Scientific School.

Respectfully submitted,

WM. H. CAMPBELL,
President of the Board of Trustees.

ANNUAL REPORT ON THE

FARM OF THE AGRICULTURAL COLLEGE.

BY GEORGE H. COOK.

The year just ending has been marked by a number of interesting and instructive experiments upon the College Farm and in the Laboratory. As a business year in farming, it has been characterized by low prices and an unusually large proportion of short crops. The winter was very severe, and the snow, which usually protects the grain and grass, passed off leaving a coating of thick, hard and clear ice, which remained on the ground for several weeks. During this time, most of the wheat was killed, and the grass greatly weakened. The damage in our northern counties was much greater than in the southern. With us it amounted to the loss of more than half the hay crop, and fully three-quarters of the wheat. The spring was dry, so that corn and other planted crops came up late and uneven. The early summer weather was favorable for the growth of corn, and for haying and the wheat harvest. The season for the oats harvest was remarkable for heavy rains and long continued wet weather. Much damage was done to the crop of oats. The whole autumn has been favorable. The crop of corn is almost if not quite unequalled, both in quality and quantity. The second crop of hay was better than the first; the root crops have been fair, and potatoes have not been better in many years.

EXPERIMENTS ON THE GROWTH OF INDIAN CORN WITH DIFFERENT FERTILIZERS.

The experiments upon the growth of Indian corn, which have been in progress for three years past, have been continued this year. The ground on which the corn was grown is the lowest upon the the farm, and was until within the last five years, a wet and poor swamp, but without any accumulation of peat or muck. The soil is clayey with considerable gravel in it. Five years ago it was thoroughly underdrained, and has since had in succession, crops of corn, oats, wheat and grass. It has been manured on the corn with barn-yard manure, and on the wheat with waste hair from the glue makers, but has not been well limed. This soil is not yet in as good condition as that of old well cultivated ground. It was chosen from our cornfield of fourteen acres, as the part most uniform in quality and in previous culture.

The area of the plots experimented on, was one-tenth of an acre each. The ground was ploughed from four to five inches deep and the corn planted in hills three and one-half feet apart, and with three or four stalks in each hill. The corn has a yellow dent kernel, rather small sized ear of twelve to sixteen rows, and has been cultivated on the College Farm, and by the late Dr. F. R. Smith, of this place, from whom it was obtained, for many years past. It was planted about the 20th of May, and was cut in the latter part of September.

Table showing experiment plots, with the number of pounds of manure per acre applied to them, with the value per acre of each manure.

FERTILIZERS.	NUMBERS OF THE PLOTS.									
	1	2	3	4	5	6	7	8	9	10
Muriate of potash	100	100	100	100	......	......	100	100	......	......
Sulphate of ammonia	200	400	200	......	......	400	......	......	......	......
Super-phosphate of lime	300	300	500	......	......	......	300	500	......	......
Blood fertilizer	......	......	......	......	......	......	500	200	......	......
Barn-yard manure	......	......	......	......	......	......	......	......	......	16t'ns
Value	$16 65	26 65	19 25	2 75	......	20 00	17 15	13 45	......	40 00

Table showing the weight of corn and of stalks, in pounds, per acre, with the values of the corn and stalks, and the gain in value of products per acre on each plot.

	1	2	3	4	5	6	7	8	9	10
Corn in pounds	8100	8200	8550	8150	7000	7100	7700	8000	6950	7650
Corn in bushels	99	100	104	100	85	86	94	98	85	93
Stalks in pounds	6500	6700	7200	6150	5500	5500	5900	6380	5100	6400
Stalks in tons	3.25	3.35	3.60	3.07	2.75	2.75	2.95	3.19	2.55	3.20
Value of corn	$74 25	75 00	78 00	75 00	63 75	64 50	70 50	73 50	63 75	69 75
Value of stalks	$14 68	14 92	15 56	14 80	12 72	12 88	14 00	14 56	12 28	13 88
Whole value	$88 93	89 92	93 56	89 80	76 47	77 38	84 50	88 06	76 03	83 63
Gain in value	$12 68	13 67	17 31	13 55	......	1 13	8 25	11 81	......	7 38

In making the computations on the amount of corn eighty-two pounds of ears have been allowed for each bushel of shelled corn, as we found on drying some that eighty-two pounds after drying, only weighed seventy pounds, which is the weight allowed for a bushel, when the corn is dry and unshelled. The prices of the commercial fertilizers are those paid in New York. The price of the corn, seventy five cents per bushel, is its market value, at the date of this report. The stalks are sold by the bundle at four cents each, and their average weight was twenty-two pounds.

FERTILIZERS.

The muriate of potash, *potassium chloride*, was a good commercial article, containing fifty per cent. of potash. Its price was two and three-fourth cents per pound, it was sprinkled on the hills after planting, and no burning or other ill effect was observed from its use.

The sulphate of ammonia contained twenty-five per cent. of ammonia, and was a good commercial sample of that chemical substance. It was in hard lumps, inconvenient and troublesome to crush fine. The price was five cents per pound.

The super-phosphate of lime, was made from three-fourths Carolina phosphate, and one-fourth burnt bones. It was bought to contain ten per cent. of soluble phosphoric acid, but on analysis, was found to contain only 8.3 per cent. soluble and reverted phosphoric acid. It contained 9.2 per cent. of *insoluble* phosphoric acid, from which I infer that it was not properly manufactured. It contained no ammonia, and was bought solely on account of its soluble and reverted phosphoric acid. The price was $1.30 per hundred pounds.

The blood fertilizer, made from slaughter house refuse, contained $9\frac{13}{100}$ per cent. of ammonia and 6.1 per cent. phosphoric acid, in ground bone. Its price was $2.12 per hundred pounds. The trial was made to compare it with sulphate of ammonia, as a source of ammonia.

The barn-yard manure was from the pile of barn-yard and stable manure, was made by well-fed animals and was well-rotted and fine. It was applied broadcast. Such manure costs us from $1.50 to $2.00 a load in town, besides the hauling, and four loads are all that one team can bring to the farm in a day. The cost is not over-stated at $2.50 per ton.

A comparison of these results indicates that the muriate of potash has increased the weight of the stalks decidedly, plots 5, 6 and 9, upon which none was used, having the smallest weight of stalks. This agrees with the results of the experiments with this substance on the growth of corn in 1872, 1873 and 1874. Those of 1872 and 1873, which were upon the lighter and naturally drained land of the farm, showed no marked increase of the grain. That of 1874, and this of the present year, show a decided increase in the weight of the corn as well as of the stalks. Both these latter were upon heavy soil, which has always been too wet to be cultivated till within the last five years. This continuous soaking may have had something to do with creating a need for potash in the soil.

No benefit appears from the use of sulphate of ammonia, when applied in increased quantity, as in plot 2, compared with plot 1; or when applied as in plot 6, compared with plots 5 and 9. The stalks appeared much larger, and the leaves broader and greener, in plot 6 than on plots 5 and 9, but they were not heavier, and they did not stand up as well. In the experiment of 1872 the stalks had the same promising appearance, but were really *lighter* than those on which no fertilizer was used.

The super-phosphate of lime has produced some effect in increasthe crops, and where the largest quantity was used, as in plots 3 and 8, there the crop was largest.

The barn-yard manure has produced less increase of the crop than any of the commercial fertilizers, except the sulphate of ammonia.

Of the fertilizers used, it will be seen that none, except that on plot 4, have paid their cost in the increased value of the crop. The sulphate of ammonia is probably mostly exhausted, and much of the potash. A large part of the super-phosphate and of the barnyard manure are still in the ground, and ready to benefit succeeding crops. And it must not be forgotten that it is the manure left over from former crops, which has put the soil in condition to raise eighty-five bushels of shelled corn to the acre, without any addition of manure to it this year. If the sulphate of ammonia had not been used at all the crop would have been just as large as it is now, and the increased crops would have paid the cost of all the other substances used.

Experiment on the growth of sweet or sugar corn. This experiment was made to try the productiveness and value of the above mentioned variety of corn. It was made in consequence of the large crop raised in Salem in the summer of 1873, by David Pettit. Our seed was obtained from him in the Spring of 1874, and a small patch of ground was planted with it, but the crop was not measured. This year a tenth of an acre of ground, well dressed with barn-yard manure, was planted with it, and the crop measured twenty bushels of ears. It was planted early in June, and was cut about the middle of September. The hills were three feet apart and had four or five stalks in each hill. They might have been closer, probably three by two feet, as planted by Mr. Pettit. The crop is a remarkably good one, and we propose to make further experiments upon this variety of corn.

Experiment on the growth of potatoes with different fertilizers. Our soil is not well adapted to potato growing. The subsoil is so close that water, after rains, does not sink away from the surface quick enough, and the beating of the rain upon the soil leaves it in such condition that a hard and close crust is formed upon it as it dries. The experiment was made upon a plot that has not been cultivated or manured much for many years. The soil is a gravelly loam. It was ploughed about five inches deep, marked out in rows two and a half feet apart, each way, and a subsoil plough was run in each mark to the depth of ten or twelve inches. The fertilizers were then scattered along in the rows, and the potatoes planted in hills. The seed was of large potatoes, cut to have two eyes on each piece, and two pieces in a hill. The cultivation was mainly with the plow. The variety was the Peerless. The vines were thickly covered with the Colorado potato bug, but by the frequent use of Paris Green, were saved from any great damage.

The fertilizers used were—

Forester's Potato-fertilizer, from H. J. Baker & Brother, 215 Pearl street, New York.

Blood Guano, from the Manhattan Fertilizing Company, Platt street, New York.

A mixture prepared on the College Farm from chemical fertilizers.

The crop per acre was computed from the product of one hundred hills of each, which was weighed, and sixty pounds allowed for for each bushel, and was as follows:

Potato-fertilizer,	221	bushels
Blood Guano,	227	“
Farm mixture,	242	“

The Potato-fertilizer, on analysis, shows the following composition:

Phosphoric acid soluble in water,	3.07	per cent.
“ “ “ in citrate of ammonia,	3.83	“ “
“ “ insoluble,	83	“ “
Potash,	11.70	“ “
Ammonia,	1.00	“ “
Lime,	8.61	“ “
Sulphuric acid,	15.85	“ “

It was sent by Messrs. Baker for trial; was used at the rate of 1300 pounds per acre; and its cost, I presume, was $26 per acre.

The blood guano is not prepared specially for potato-growing, though an excellent manure. Its composition is as follows:

Phosphoric acid, soluble in water,	6.40	per cent.
“ “ soluble in citrate of ammonia,	.51	“
“ “ insoluble,	4.61	“
Potash, soluble in water,	.72	“
Ammonia,	3.10	“

This fertilizer was sent by the Manhattan Fertilizing Company for trial on the farm, and was used at the rate of eleven hundred pounds per acre. Its cost per acre was about $25.

The farm mixture was made of four hundred pounds of superphosphate of lime, two hundred sulphate of ammonia, one hundred pounds of muriate of potash, three hundred pounds of plaster, or one thousand pounds per acre. Its cost was $20. Its analysis would show

Phosphoric acid, soluble and reverted, - -	3.3	per cent.
Potash, soluble in water, - - - - -	5.0	"
Ammonia, - - - - - - - -	5.0	"

The vines were much the most luxuriant where the blood-guano was used, and next to these in appearance were those grown with the farm mixture.

In quality, however, the potatoes were in the reverse order, those grown with the potato-fertilizer are still nearly free from rot; those grown with the farm-mixture have shown some signs of rot, and those grown with the blood-guano were rotting so fast that we were glad to sell them at a price much below that of sound potatoes.

The experiments are satisfactory in regard to the amount of the crop, and the mode of cultivation. They show, too, that potash is necessary for the growth of sound potatoes. Ammonia does not appear to have been of much benefit. In another trial I should double the amount of potash, and phosphoric acid, diminish the sulphate of ammonia one-half, and keep the sulphate of lime as now. This would only increase the cost to $23 an acre, and I think would suit the crop much better.

Experiments upon wheat were begun with Lister's bone-meal, blood-guano, muriate of potash, and other fertilizers, but the crop was so badly damaged by the ice last winter, that no conclusions can be drawn from them. Others of the same kind have been begun on the wheat now growing.

Experiments with muriate of potash upon grass have not yet shown any very marked results, but are in progress and will be continued.

Experiments upon composts of, muck with lime, and muck with lime slaked with brine are in progress, but the chemical examination of them is not yet completed.

CROPS.

Wheat.—The crop this season was very light. A large portion of the plants were winter-killed. The ground was covered with ice for several weeks, during which the damage was done. We had ten acres of carefully prepared and fertilized ground, and the grain was well started at the beginning of winter. But on large spots every plant was killed, and on most of the ground the plants were thin and weak. The whole field only yielded seventy bushels.

Rye.—This grain has been sown only to provide a good supply of green fodder for cows, during the last half of May and the first half of June, if it should be needed. It is sown on rich ground and about three bushels of seed are sown to the acre. Our plot this year was only half an acre, and as the crop was not needed for fodder, it was allowed to ripen. The yield was twenty four and a-half bushels, which is forty-nine bushels per acre

Oats.—This grain was grown on about eleven and one-third acres of the corn ground of last year. The promise for this crop was very encouraging; but the army worm attacked it and cut off a large per centage of the grains, leaving them loose upon the field. Only three hundred and fifty bushels were harvested or about thirty-two bushels per acre.

Indian corn, was grown upon fourteen acres, about twelve of which was sod. A compost of plaster, coal ashes, hen-manure, and blood-manure, was put on the corn hills after planting. This cost about $3 an acre, and was the only manure used. Eighteen hundred bushels of ears of corn were gathered from the field. This is equal to nine hundred bushels of shelled corn, or sixty-four bushels per acre. This field is a new one, cleared only a few years since, and the crop is good for the soil. The weather was very dry at planting, and for some time after, and the corn did not come up quickly. In fact, it came up much slower where the manure was put on, than where there was none.

Hay was cut on something over thirty acres of ground, but so severe was the winter of last year, that the grass was weakened and almost destroyed by it. There was not more than half a crop, thirty acres yielded only about forty tons of hay, against ninety tons last year.

Fodder corn has been grown in greater quantity than in any former year. For both summer and winter food for cattle, it is unequalled in quality and cheapness. The best varieties to grow, and the proper culture and manures, so as to obtain the most nutritious fodder, and that which is most cheaply grown and cured, must be subjects of careful and continued experiments.

Potatoes were grown on about three acres besides the experiment plots, and the crop was two hundred and fifty bushels. The variety was Early Rose. The experiments upon manures and cultivation of potatoes, have already been given under that head. We are planning for further experiments on the soil, manures, culture and varieties of potatoes most profitable to grow on the farm.

Mangold Wurzel beets.—One acre has been cultivated in this root crop. It is much more difficult to grow successfully on our soil, than either corn or grass, and we have reduced the space heretofore given to it. The ground was heavily dressed with barn-yard manure. The hot and dry weather in May killed most of the seeds, so that there was only a scattering stand of plants that grew. These were of good size and quality, and the acre yielded seven hundred and fourteen bushels. The varieties cultivated were the Orange Globe, Long Red, and Lane's Sugar Beet. We have uniformly secceeded best with the Orange Globe. They are raised for the food of cows in spring.

Carrots.—Three acres of ground have been cultivated in carrots. Owing to the unfavorable weather in the early part of the season, the seed did not come up well. The young carrots are very weak and delicate, and in dry weather they have not strength to break through the slight crust which forms on the surface of the ground, and most of them perish, unless rain comes to release them. Those which survived, grew well and were very large and fine. We have gathered five hundred bushels. The variety is Bliss' Improved Long Orange. They are grown for market, and are chiefly sold to parties in New Brunswick for feeding horses. The blanks in the carrot rows were planted in ruta-baga turnips, and one hundred bushels were gathered from this ground.

Turnips.—Ruta-baga, Yellow Stone, Cow-horn, and the common Flat turnip, have been grown on three acres of ground. For market, the Ruta-baga is our only dependence, though they are longer in growing, cost more for labor, and planting comes at a more inconvenient time. The other varieties are raised much more cheaply for cattle food; they grow in a shorter time, can be planted later, and so are better adapted for a catch crop, after failures in spring crops, or after early summer crops have been taken off. We have two hundred and fifty bushels of ruta-bagas, one hundred and sixty bushels of yellow globe, three hundred bushels of cow-horn, and a few bushels of flat turnips.

Some turnip seed, bought under the name of the French-horn turnip, was sown at the same time with the cow-horn, but proved an entire failure.

Cabbage.—One acre of ground has been planted with this vegetable. It has been more damaged by *club root* than in any season before this, and the crop is scarcely medium. Various trials were made to stop the development of the disease after it was detected, but none were successful. It does not appear to be so common or troublesome in other parts of the state as it is with us. Experiments must be made with different substances to prevent it. We shall first try very heavy manuring with calcareous marl, compost of muck, lime and salt, or any other form of fine carbonate of lime. The losses from this cause are large among most of our market gardeners.

STOCK.

The horses and mules remain as at the date of the last report.

The cows are still kept for milk, and are fed in the stable, not depending on pasture or being turned out more than enough for healthy exercise. They have averaged thirteen in number through the year, and twenty-eight thousand and sixty quarts of milk have been sold, besides that consumed on the farm.

The swine on the farm have not heretofore received much attention. There are now Poland–China and Essex pigs, and it is intended to have representatives of the breeds that are considered desirable.

DONATIONS.

One ton of super-phosphate of lime, from Messrs. Lister Brothers, manufacturers, Newark, N. J. One barrel, two hundred and fifty pounds, potato fertilizer, from Messrs. H. J. Baker & Brother, manufacturers and dealers, 215 Pearl street, New York. One bag, two hundred pounds, blood-guano, from the Manhattan Fertilizing Company, Platt street, New York.

Now that improvements upon the land are well advanced, and most of the expenses of the farm are for producing crops and marketable products, a closer scrutiny of expenses and returns becomes possible. The expenses for labor, the interest on capital, and the worth of manures are prominent subjects of inquiry. It is questionable whether there is as much profit in raising crops which require a great deal of labor and sell for large prices, as in raising our great staples, corn, rye, hay, oats and potatoes, which are raised mainly by the use of implements and horse-power with little hand-labor. Staple crops grown on the college farm are quite as profitable as any other.

The means for carrying on the operations of the college farm are very limited. They are not sufficient to provide necessary buildings, stock, implements and labor. To make conclusive experiments is expensive, and more means must be provided or the farm cannot do the work which is now demanded in the interest of agriculture, and which it is ready to undertake. It is hoped that provision may be made for experiments in greater number, and on more varied subjects another year.

COURSES OF STUDY

IN

RUTGERS SCIENTIFIC SCHOOL.

Three distinct courses of study are included in the Schedule which follows:

I. A Course in Civil Engineering and Mechanics.

II. A Course in Chemistry and Agriculture.

III. A Special Course in Chemistry.

During the first and second years the studies of the two full courses are the same, and are designed to furnish a suitable introduction to the pursuit of the higher branches in either.

During the last two years the subjects of Higher Mathematics, Mechanics and Engineering in the Engineering course, are replaced by Analytical Chemistry, practice in the Laboratory, and Agriculture in the second course. The remaining subjects are pursued by the students of both courses together.

The course of study for the first two years in this Department is arranged so as to be complete in itself. It is especially designed to meet the wants of those who cannot take the entire four years course, but who desire to fit themselves as Land Surveyors. Students leaving at this period of the course, receive from the faculty a certificate of their attainments.

Special Students are received, and allowed to take any part of the above course; and particular provision is made for them, especially in the Laboratory, in Mathematics and Surveying.

The Special Course in Chemistry and Agriculture, occupying two years, is designed for those who wish to devote themselves exclusively to these branches. Opportunities of a very superior character are afforded to such students under the charge of Professors Cook, Smock, and Van Dyck, in the new Laboratory building.

SPECIAL PROVISION IS ALSO MADE FOR STUDENTS WHO DESIRE, AFTER COMPLETING THE REGULAR COURSE OF STUDY, TO TAKE POST-GRADUATE STUDIES.

COURSE OF STUDY.

FRESHMAN YEAR.

Exercises during the year in Composition and Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. French. 2. Mathematics—Loomis' Algebra, from Quadratic Equations. 3. Natural History—Dalton's Physiology; Lectures. 4. Rhetoric—*Haven;* Lectures. 5. Draughting—Construction of Problems.

SECOND TERM.

1. French. 2. Mathematics—*Loomis' Geometry*, from Book IV. 3. Natural History—Zoölogy; *Lectures.* 4. Elocution—*Lectures.* 5. English Literature—*Shaw's Manual; Craik's English of Shakspeare.* 6. Draughting.

THIRD TERM.

1. French. 2. Mathematics—*Loomis' Trigonometry*, Plane and Spherical. 3. Natural History—*Gray's Botany; Lectures.* 4. English Literature—*Shaw's Manual; Lectures.* 5. Draughting.

SOPHOMORE YEAR.

Exercises during the year in Composition and Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. Surveying—*Murray's Manual;* Field Exercises and Mapping. 2. Descriptive Geometry—*Church.* 3. Chemistry—*Lectures.* 4. Mental Philosophy—*Haven.* 5. History—*French Outlines.*

SECOND TERM.

1. Descriptive Geometry—*Church*; Construction of Problems. 2. Chemistry—*Lectures*. 3. Mental Philosophy—*Haven*. 4. History—*Freeman's Outlines*.

THIRD TERM.

1. Leveling and Railroad Curves—*Henck's Field Book*; Field Practice and Plotting. 2. Shades, Shadows, and Perspective—*Church*; Construction of Problems. 3. Chemistry—*Lectures*. 4. Mental Philosophy—*Lectures*. 5. History—*Creasy's Constitutional History of England*.

JUNIOR YEAR.

Course in Civil Engineering and Mechanics.

Exercises during the year in Composition and Original Declamation
Bible Class each Sabbath morning.

FIRST TERM.

1. German. 2. Analytical Geometry—*Peck*. 3. Natural Philosophy—*Snell's Olmsted*. 4. History of Civilization—*Guizot*. 5. Constitutional History of the United States—*Text book and Lectures*. 6. Draughting.

SECOND TERM.

1. German. 2. Differential and Integral Calculus—*Peck*. 3. Natural Philosophy—*Snell's Olmsted*. 4. Political Economy—*Bowen and Perry*. 5. Constitutional History of the United States—*Text-book and Lectures*. 6. Draughting.

THIRD TERM.

1. German. 2. Mechanics—*Bartlett or Smith*. 3. Astronomy—*Loomis*. 4. International Law.—*Woolsey*. 5. Draughting.

JUNIOR YEAR.

Course in Chemistry and Agriculture.

Exercises during the year in Composition and Original Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. German. 2. Mineralogy and Analytical Chemistry—Text-book, with Laboratory Practice. 3. Agriculture—Lectures at the Farm. 4. Natural Philosophy—*Snell's Olmsted.* 5. History of Civilization—*Guizot.* 6. Constitutional History of the United States—Text-book and Lectures.

SECOND TERM.

1. German. 2. Analytical Chemistry—Text-book, with Laboratory Practice. 3. Agriculture—Lectures. 4. Natural Philosophy—*Snell's Olmsted.* 5. Political Economy—*Bowen and Perry.* 6. Constitutional History of the United States—Text book and Lectures.

THIRD TERM.

1. German. 2. Analytical Chemistry—Text-book, with Laboratory Practice. 3. Agriculture—Vegetable Physiology. 4. International Law—*Woolsey.*

SENIOR YEAR.

Course in Civil Engineering and Mechanics.

Exercises during the year in Composition and Original Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. Mechanics—*Bartlett, or Smith.* 2. Geodesy—Theory and Practice of Triangulation. 3. Chemistry—Lectures on Organic Chemistry. 4. Moral Philosophy—Wayland and Hopkins.

SECOND TERM.

1. Engineering—*Mahan.* 2. Geodesy—Practical Astronomy; Indeterminate Analysis. 3. Chemistry—Lectures on Chemical Physics. 4. Moral Philosophy—Butler's Analogy.

THIRD TERM.

1. Engineering—Bridge-Building and Railway Practice. 2. Architecture—Lectures. 3. Geology—Lectures; Geological Excursion. 4. Moral Philosophy—Butler's Analogy.

SENIOR YEAR.

Course in Chemistry and Agriculture.

Exercises during the year in Composition and Original Declamation. Bible Class each Sabbath morning.

FIRST TERM.

1. Mining and Metallurgy. 2. Chemistry and Principles of Agriculture—Lectures. 3. Laboratory Practice. 4. Moral Philosophy—*Wayland and Hopkins.*

SECOND TERM.

1. Agriculture—Its Methods and Products. 2. Chemistry—Lectures on Chemical Physics. 3. Laboratory Practice. 4. Moral Philosophy—Butler's Analogy.

THIRD TERM.

1. Agriculture—Animal Physiology; Care and Management of Domestic Animals. 2. Architecture—Lectures. 3. Geology—Lectures; Geological Excursion. 4. Moral Philosophy—Butler's Analogy.

SPECIAL COURSE IN CHEMISTRY.

FIRST YEAR—FIRST TERM.

1. Elements of Chemistry—Text Book and Lectures. 2. Blowpipe Analysis. 3. Elements of Mineralogy.

SECOND TERM.

1. Physics and Chemistry—Text Book and Lectures. 2. Chemical Analysis—Qualitative.

THIRD TERM.

1. Chemical Analysis—Qualitative and Quantitative. 2. Vegetable Physiology.

SECOND YEAR—FIRST TERM.

1. Chemical Analysis—Analysis of Minerals, Ores, &c. 2. Mineralogy—Determinative.

SECOND TERM.

1. Chemical Physics—Heat, Electricity, Magnetism, Galvanism, and Electro-magnetism—Text book and Lectures. 2. Analysis of Fertilizers and Chemical Products.

THIRD TERM.

1. Lectures on Geology. 2. Chemical Analysis—Special Investigations.

ELEVENTH ANNUAL REPORT

OF THE

BOARD OF VISITORS

OF THE

State Agricultural College.

To His Excellency, Joseph D. Bedle, Governor of the State of New Jersey:

SIR:—The Board of Visitors of the New Jersey State Agricultural College, beg leave to present their eleventh annual report:

During the year which has passed since our last report, two meetings of the Board have been held at the college in New Brunswick, as required by law; and a committee of the Board has also visited and examined the farm of the Agricultural College.

The first meeting was held December 22d, 1874, and the members of the Board attended the examinations of the different classes, inspected the drawings, witnessed the work of the students in the chemical laboratory, and also inquired into the working of the institution, and the occupations of the students who have received instruction and gone out from it. A resolution was unanimously adopted expressing the satisfaction of the Board in the progress of the students, and in the teaching they have received.

The second meeting was held on the 18th of June, 1875. At this time the three lower classes were examined in all the studies pursued during the last term of the year, and the Theses of the graduating class were heard. The following resolutions were adopted by the Board at the close of the visit:

Resolved, That the Board of Visitors of the New Jersey State Agricultural College, having attended the semi-annual examination of its students, desire to express their real gratification with the proficiency manifested by them in the various studies pursued by them during the past year.

Resolved, That they heartily approve and endorse the methods of instruction adopted in the institution, and believe that under the careful and thorough training of the professors, these young men will be qualified for extensive usefulness in their several callings.

Resolved, That they have examined the admirable drawings submitted to their inspection, and have listened with unfeigned pleasure to the Theses read by the graduating class.

The manly and practical character of the studies made for their graduating exercises is well shown in the titles of their Theses—of which a list is here inserted.

THESES.

Civil Engineering Section.

"WATER WHEELS," with reference to the wheel at the New Brunswick Water Works.
HOWARD V. BUTTLER, New Brunswick, N. J.

"PAVEMENTS," with detailed description of Telford pavements in New Brunswick, N. J.
PETER A. MONFORT, of New Utrecht, L. I.

"THE PARABOLIC TRUSS,"
ARTHUR L. TITSWORTH, of Plainfield, N. J.

A review of the WATER WORKS, at Hudson, N. Y.
FRANK VAN WYCK, of Poughkeepsie, N. Y.

The HORSE CAR ELEVATOR, of the North Hudson Car Company, at Jersey City.
CHARLES L. D. WASHBURN, of Jersey City, N. J.

Chemical Section.

"SUGAR," its manufacture.
GANSEVOORT V. V. CORTELYOU, of New Brunswick, N. J.

"JAPANESE METALLURGY."
ICHY ZO HATTORI, of Tokei, Japan.

"ANALINE COLORS, their manufacture and uses."
HENRY L. JANEWAY, JR., New Brunswick, N. J.

"ANALYSIS OF DRINKING WATERS."
ROBERT A. MEEKER, Plainfield, N. J.

The "AVERILL CHEMICAL PAINT," a discussion of its composition and durability.
JACOB E. WARD, Madison, N. J.

At the June meeting, two members of the board, David Pettit, of Salem, and Wm. R. Janeway, of Somerset, were appointed a committee to visit the College Farm, and report to the president. Their report is herewith submitted.

"We, the committee appointed to visit the farm of the Agricultural College, met at the house of Prof. G. H. Cook, on the seventh day of the ninth month, 1875, according to previous arrangement, and proceeded with him to the farm of the college under his charge; and we will here remark, that until near harvest time there was a severe drouth in that section, almost unprecedented, and therefore crops, until after that time, were most unpromising.

"The first crops we visited were the roots. These are raised on the farm extensively for market, as they are there a paying crop. The beets and carrots did not stand well, owing to the extreme dry weather of the spring, and the surface ground being bakey, the young plants could not get through the ground well, and many of them could not in consequence become well established, as one of your committee observed at the time the visitors met at the Scientific School. This baking of the surface is increased we believe by the continued cropping of the same land without a change to a sod, and that such a change tends greatly to increase its mellowness. The Prof. informed us he intends to make a change in this direction, in cropping hereafter. The roots of the beets and carrots which stood, were large so they promised a fair crop, having improved greatly by the late rains.

"The turnips were planted much later and had the full benefit of the summer rains to start them, and were very promising.

"The disease called "Club-foot," was in the cabbage, doing serious damage to the crop, as shown by their wilty and dying appearance where affected. Where they were clear of the disease, they too were promising.

"The wheat crop had been light, owing to the extreme dry spring after being badly winter-killed by the sleet and frost of last winter; but which did not injure the young timothy, but seemed to give it a new impetus of growth, and this we found well set and most luxuriant where the wheat had been harvested. The Prof. informed us that it out-topped the wheat before harvest time.

"The meadow field we found well set in a grass sod and in good condition for a change of crops when needed. This land when visited by one of the committee soon after the farm was purchased, was in the wildest and roughest state imaginable. The timber had been taken off and stumps dug and removed with their holes remaining, and the undergrowth of large upland whortleberries had been plowed, or rather in plowing the ground, they had been dragged into heaps and so remained. This its then condition added to its worthless character of being poor, wet and sodden, makes the contrast from what it then was from underdraining, pulverizing, leveling and improving the soil, the most remarkable.

"As the hay crop was deficient, corn had been planted or sowed for fodder to make up that deficiency, or as a substitute for hay, as this crop produces much more good fodder to the acre than any other crop cultivated by the farmer. This was very heavy and nearly in a fit state to be cut and dried.

"The field corn was good—the best we have yet seen on the farm. The Professor called our attention to strips of this corn of one-tenth of an acre each, on which he had been experimenting with different fertilizers. The difference in the growth of the corn where some of them had been applied, was very perceptible. Some of them made the corn very heavy, but we could not estimate the difference to any certainty. Measuring or weighing the crops when matured from where the different fertilizers were applied, and comparing them with other strips, with and without fertilizers, will be the only reliable tests of the results and their respective values; and these test results will in time, as published in the reports of the farm, become reliable for farmers generally, but more particularly in that section of the state and on land of the character of that experimented on.

"Our attention was called, too, to the potatoes, where he had used three kinds of fertilizers, and which would turn, we thought, two hundred bushels to the acre, some, more. The fertilizer made by him, and which cost only half what the others did to the acre, we thought produced the best results. He had the bugs kept down by a plentiful supply of Paris green.

"There are other matters connected with farming besides fertilizers which might be experimented on and tested, and which might become, if so tested, of vast importance to the farming community. Among these we would suggest that the proper depth to plow and pulverize under all circumstances, and also the depth to apply the fertilizers; how compact the soil should be made by rolling both before and after seeding; the best method and the cheapest to absorb and retain the moisture in the soil as it rises from the subsoil in a dry time for the benefit of the growing crops, and so prevent in a measure its rapid evaporation; for it is a well-known fact that moisture will rise at such times for a depth of several feet, five to eight or more, and the harder the subsoil and soil are the more rapidly the moisture will rise and evaporate, provided there is no obstruction in the subsoil to prevent its so rising, and nothing in the soil to hold the moisture and prevent evaporation. These are among the most important considerations connected with farming, and should be settled definitely by fair experiments by agricultural colleges, or experimental stations, for they can be settled in no other way.

"One farmer plows deep and manures the surface well and realizes therefrom a good crop of corn, and attributes his success to deep plowing alone. Another has a rich subsoil, and by plowing deep succeeds well and attributes his success, too, to deep plowing, and their accounts being published as the results of deep plowing lead the people astray, because if all the circumstances connected therewith were made known or published, might prove the results proceeded from other causes, and are therefore not reliable for evidence and cannot settle anything.

"One man writes from Nebraska that by plowing eight inches deep he succeeded in raising fifty-two and a-half bushels of wheat to the acre, and attributes his success to deep plowing, while another writes to one of your committee that he seeded his land in Kansas with wheat and gathered fifty bushels heaping measure to the acre, without plowing. Here are conflicting accounts, not resulting from the depth of seeding, but from other causes.

"Our agricultural papers all over our country are filled with such statements as the results of certain modes of farming, when the results may, and do no doubt many times, proceed from entirely different causes.

"And we will here suggest that the best interest of the farmers demands (and of the state indirectly, as farming is the basis of all other industries,) that experimental stations be established on our various soils so as to settle all these questions experimentally, which will be scientifically and therefore definitely, otherwise farmers will continue trying projects and meet with disappointments.

"If experimental stations were established, they would give confidence in their experiments.

DAVID PETTIT,
WM. R. JANEWAY, } *Committee.*"

In justice to the state and to the trustees of Rutgers College, we wish to state distinctly our judgment that this Institution is justifying the action of congress in providing for the liberal education of young men, who are to engage in industrial pursuits, for all its graduates, with scarcely an exception, have entered upon practical and business life and are occupying positions of usefulness they could not have filled but for the education here received. We regret that some of our counties are not filling the scholarships belonging to them, and so are losing a valuable right.

We would also report that the trustees of Rutgers College have faithfully fulfilled their obligations to the state in providing college buildings and an experimental farm for the Agricultural College, without charge upon the U. S. fund; and now that by their efforts the success of the college is assured, and its usefulness demonstrated, we think the state would do a service to the cause of industrial education by aiding the trustees to enlarge and make more complete their facilities for instruction.

All of which is respectfully submitted.

WM. PARRY,
President of Board of Visitors.

CONTENTS.

List of State Board of Visitors, - - - - - - - - - Page 3
Report of the Board of Trustees, - - - - - - - - - " 5
Report of the College Farm, - - - - - - - - - - " 11
Courses of Study, - - - - - - - - - - - - - - " 21
Report of State Board of Visitors, - - - - - - - - " 27

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